Updates on the OMI Cloud Pressure Product Derived from Rotational Raman Scattering

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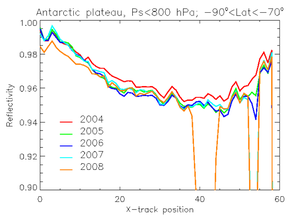
Abstract

Cloud pressures are needed for accurate retrieval of ozone and other trace gases from satellite observations. OMI cloud pressures are derived from rotational Raman scattering (RRS). This effective cloud pressure or optical centroid pressure (OCP) approximates an average pressure reached by backscattered solar photons. The OCP product, known as OMCLDRR, is currently available from Collection 3, version 1.9.0. A main change made in this latest version as compared with previous v1.8.0 is the use of time-dependent soft calibration of TOA radiances. The soft calibration procedure is repeated every year to account for possible changes in the OMI calibration. This time-dependent soft calibration (TDSC) is able to significantly reduce striping and trends in the OCP that are likely caused by instrument changes. Improvements in ozone retrievals from OMI due to the use of OMCLDRR v1.9 are considered. We compare multi-year OCP record with Aqua/MODIS cloud-top pressures collocated to nominal OMI pixels for various latitude bins.

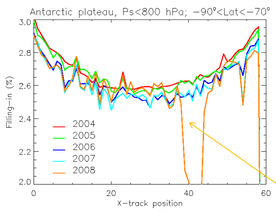
OMCLDRR basics

- Cloud pressures are retrieved from the high-frequency structure of TOA radiance caused by rotational Raman scattering. The other OMI cloud pressure algorithm (OMCLDO2) retrieves cloud pressures from the oxygen dimer absorption band at 477 nm.
- Fitting window 345.5 to 354.5 nm. Reflectivity at 354.1 nm.
- Soft calibration to reduce striping and trends. Over Antarctic Plateau the scene pressure is assumed be equal to the surface pressure.
  (1) Compute spectral residuals (observed minus calculated radiances) for each swath position.
  (2) Use the calculated residuals to correct TOA radiances
  (3) Data from Dec 2004 in v1.8.0, not updated (instrument assumed stable)
  (4) Soft calibration is repeated for every year (data from Dec.) in v1.9.0

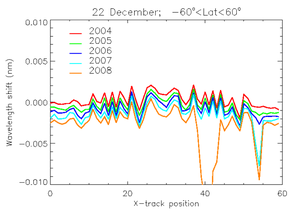
OMCLDRR v1.8.0 trends



Reflectivity decreased by about 2% since 2004



Decreasing RRS filling-in

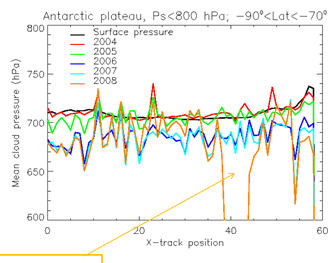


Wavelength shift trend

Application of the time dependent soft calibration (TDSC)

No clouds are assumed over Antarctic Plateau. Thus, the retrieved cloud pressure should be equal to the surface pressure.

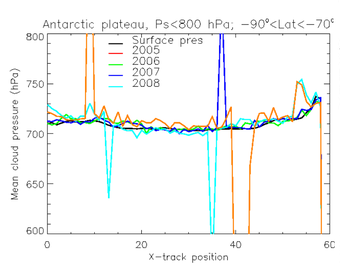
v1.8.0



Row anomaly

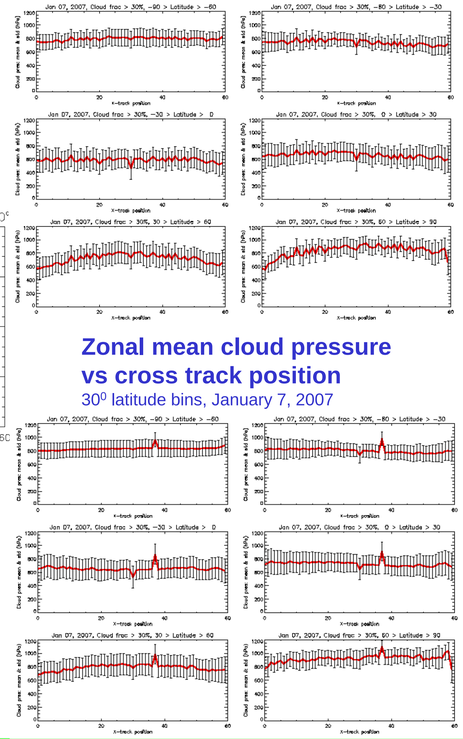
Difference between the retrieved pressure **(color lines)** and surface pressure **(black line)** is increasing.

v1.9.0



TDSC applied: the retrieved pressure is close to the surface pressure (except for a few cross-track positions).

TDSC reduces striping in cloud pressures

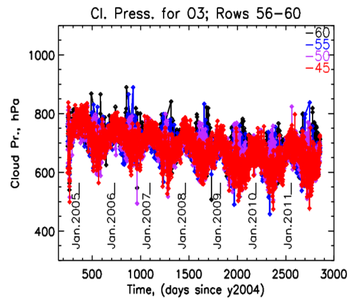


Zonal mean cloud pressure vs cross track position

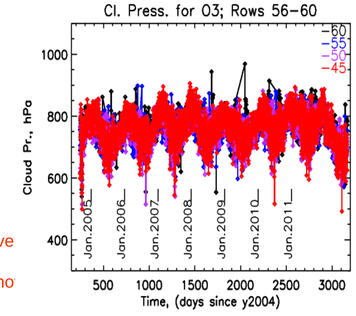
30^0 latitude bins, January 7, 2007

TDSC eliminates long-term trends in cloud pressures

v1.8.0



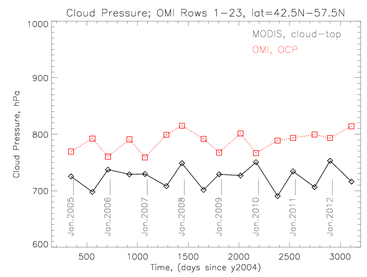
v1.9.0

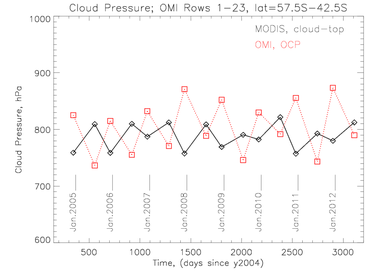


Best results ove Antarctica Reduced but no eliminated striping elsewhere

Cloud pressures from OMCLDRR v1.9.0 vs. MODIS cloud-top pressures

The comparison confirms that no noticeable remaining trends in OMI cloud pressures are observed.



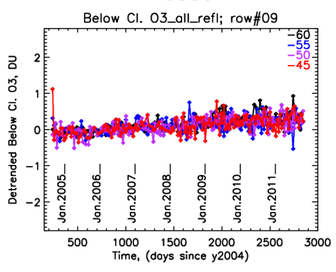


MODIS cloud-top data from Collection 5

Effects on ozone retrievals

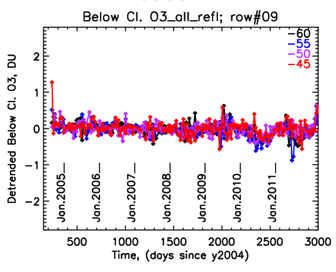
Effects on ozone below clouds

v1.8.0



Increasing ozone amounts below clouds due to decreasing cloud pressure

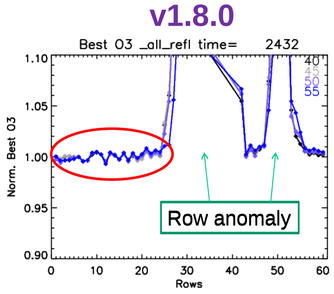
v1.9.0



TDSC removes small ozone trend

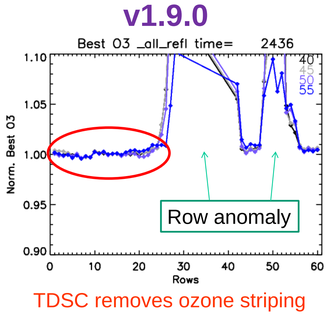
Effects on the cross-track dependence of total ozone retrievals (Sep 2010)

v1.8.0



Ozone striping due to striping in cloud pressures

v1.9.0



TDSC removes ozone striping

Conclusions

OMCLDRR v1.8.0 products exhibited observable trends: decreasing reflectivity and cloud pressures. Striping was significantly increasing.

Time-dependent soft calibration implemented in OMCLDRR v1.9.0 is able to significantly reduce the striping and trends.

OMCLDRR v 1.9.0 removes long-term trends in cloud pressures and ozone amounts below clouds. The total ozone x-track homogeneity is improved.

A comparison of OMI cloud pressures with MODIS cloud-top pressures shows that no noticeable remaining trends in OMI cloud pressures are observed.

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